8.—A Review of the Gekkonid Lizard Genus Heteronota Gray, with a Description of a New Species from Western Australia

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A review of the nominal species of the gekkonid lizard genus *Heteronota* reveals that *binoei* has been until present the only recognizable member in the genus. A new species of *Heteronota* is described from the North-West Natural Region of Western Australia. This new species appears to be restricted to subterranean cavities.

Introduction

Collections of herpetological material from the more isolated regions of Australia have greatly increased within recent years and doubtless will provide the basis for the description of many new species. It must be emphasized, however, in view of the large number of names already applied to various parts of the populations and the almost complete lack of knowledge of relationships, that a generic revision or review of the nominal species should accompany the recognition of these novelties. As an example of the case in point, the extremely variable dorsal body scalation and colour pattern found in the gekkonid lizard genus *Heteronota* has led to considerable confusion, with the description of a large number of species. The following generic diagnosis and review of the nominal species of *Heteronota* is a necessary preliminary to the description of a new species in the genus.

Diagnosis of the Genus Heteronota

Heteronota can be distinguished from all other genera of the Gekkonidae by the following combination of characters: terrestrial species with long slender digits; distal phalangeal elements slightly angulate; subdigital lamellae large, rectangular and swollen; a pair of subapical plates; two rows of scales covering sides of digits; subcaudals greatly enlarged transversely; dorsal body scales heterogeneous, consisting of large trihedral tubercles in regular or irregular longitudinal rows and separated by small smooth or keeled conical granules; ventral body scales large, smooth and imbricate; a short angular series of preanal pores in males; cloacal sacs in males and females; a single pair of cloacal bones in males; mental and postmentals large; primary postmentals in contact behind mental; rostral and first supralabial border nostril; pupil with emarginations on both anterior and posterior margins.

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Nominal Species of Heteronota

The present review of nominal species includes all described forms known to be based on examples of *Heteronota* (Group A) and also those which have been erroneously referred to the genus (Group B). Each name is presented in its original form and followed by a citation of the original description and type locality. The present status of the species, where it differs from the original, follows the citation with a reference to the author(s) who made the initial change. If no reference is given the present author assumes the responsibility for the synonymy. The generic name which I regard as being applicable to the genus is placed in square brackets when it differs from that of the author who made the initial change. Following both Groups A and B there is a discussion elucidating some of the synonymy.

Group A

Heteronota binoei Gray 1845, Cat. Lizards Brit. Mus., p. 174, type locality: Houtman's Abrollos, Western Australia. Type species of *Heteronota* by elimination.

Eublepharis derbianus Gray 1845, Cat. Lizards Brit. Mus., p. 274, type locality: Port Essington, Northern Territory = *Heteronota binoei* Gray *fide* Günther 1867, Ann. Mag. Nat. Hist., ser. 3, vol. 20, p. 50 and Gray 1867, The Lizards of Australia and New Zealand, London, p. 6.

Hoplodactylus (Pentadactylus) australis Steindachner 1867, Reise der Novara (Reptilien), p. 18, type locality: New South Wales = *Heteronota binoei* Gray *fide* Günther 1867, Ann. Mag. Nat. Hist., ser. 3, vol. 20, p. 50 and Gray 1867, The Lizards of Australia and New Zealand, London, p. 6.

Phyllodactylus anomalus Peters 1867, Mber, Akad. Wiss. Berlin, p. 14, type locality: Rockhampton, Queensland = *Heteronota derbiana* (Gray) *fide* Boulenger 1885, Cat. Lizards Brit. Mus., vol. 1, p. 75.

Neither Günther (1867) nor Gray (1867) gave any evidence for synonymizing *Eublepharis derbianus* with *Heteronota binoei* and a number of later workers continued to recognize both species (Boulenger 1885, Oudemans 1894 and Zietz 1920). Lucas and Frost (1896), Procter (1923), Kinghorn (1924), and Loveridge (1934) studied large series of *H. binoei* and supposed *E. derbianus* and have confirmed Günther's and Gray's original action I believe beyond any reasonable doubt.

Group B

Hetcronata kendallii Gray 1845, Cat. Lizards Brit. Mus., p. 174, type locality: Borneo = *Gonatodes* [*Cnemaspis*] *kendalli* (Gray) *fide* Boulenger 1885, Cat. Lizards Brit. Mus., vol. 1, p. 63.

Heteronota pelagica Girard 1857, Proc. Acad. Nat. Sci. Philad., p. 197, type locality: Feejee and Navigator Islands = *Gymnodactylus [Cyrtodactylus] pelagicus* (Girard) *fide* Boulenger 1885, Cat. Lizards Brit. Mus., vol. 1, p. 40.

Gymnodactylus (Hetcronota) arfakianus Meyer 1874. Mber. Akad. Wiss. Berlin, p. 129, type locality: New Guinea = *Gymnodactylus [Cyrtodactylus] pelagicus* (Girard) *fide* Boulenger 1885, Cat. Lizards Brit. Mus., vol. 1, p. 40.

Heteronota fasciata Macleay 1877, Proc. Linn. Soc. N.S.W., vol. 2, pt. 1, p. 100, type locality: Hall Sound, New Guinea = *Gymnodactylus [Cyrtodactylus] heteronotus* Boulenger 1885, Cat. Lizards Brit. Mus., vol. 1, p. 41.

Hetoronota marmorata Macleay 1877, Proc. Linn. Soc. N.S.W., vol. 2, pt. 1, p. 100, type locality: Fitzroy Island and Endeavour River, Queensland = *Gymnodactylus [Cyrtodactylus] cheverti* Boulenger 1885, Cat. Lizards Brit. Mus., vol. 1, p. 41.

Heteronota eboracensis Macleay 1877, Proc. Linn. Soc. N.S.W. vol. 2, pt. 1, p. 101, type locality: Cape York, Queensland = *Cyrtodactylus pelagicus* (Girard).

Heteronota walshi Kinghorn 1931, Rec. Aust. Mus., vol. 18, no. 5, p. 268, type locality: Boggabri, New South Wales = *Phyllurus walshi* (Kinghorn).

Heteronota binoci remained as the only species by Gray's original definition of that genus, when Boulenger (1885) referred *kendalli* to the genus *Gonatodes*. *Heteronota binoei* is therefore considered the type species by elimination (see International Code of Zoological Nomenclature, 1961, Rec. 69B, 3).

Boulenger (1885) referred *Heteronota fasciata* and *H. marmorata* to the genus *Gymnodactylus* (now in part *Cyrtodactylus*, see Underwood 1954) apparently solely on the basis of Macleay's original descriptions. Boulenger was forced to provide new specific names (*heteronotus* and *cheverti*) for both species as Macleay's names were preoccupied in *Gymnodactylus*. Loveridge (1934) has since synonymized *G. heteronotus* and *G. cheverti* with *C. pelagicus*.

Loveridge (1934) referred *Heteronota eboracensis* to the synonomy of *H. binoei*, however, its affinities appear to lie within the genus *Cyrtodactylus*. Specimens of *Cyrtodactylus pelagicus* from the Cape York Peninsula, Queensland, agree in all respects with the original description of *H. eboracensis*.

The holotype of *Heteronota walshi* has not been examined, but, judging from the original description alone, the species is clearly referable to the genus *Phyllurus*.

From this review of nominal species, *Heteronota binoei* is considered to be the only recognizable species in the genus. While studying the large series of *H. binoei* in the collections of the Western Australian Museum (W.A.M.) and the Department of Zoology of the University of Western Australia, eight specimens from several localities (see Fig. 1) in the North-West Natural Region of Western Australia (Clarke 1926) have proved to be extremely different and are here described as a new species. All of the recently collected material of this species, where accurate locality and habitat information are available, indicates that it is restricted to mines and natural subterranean cavities and it is therefore described as:

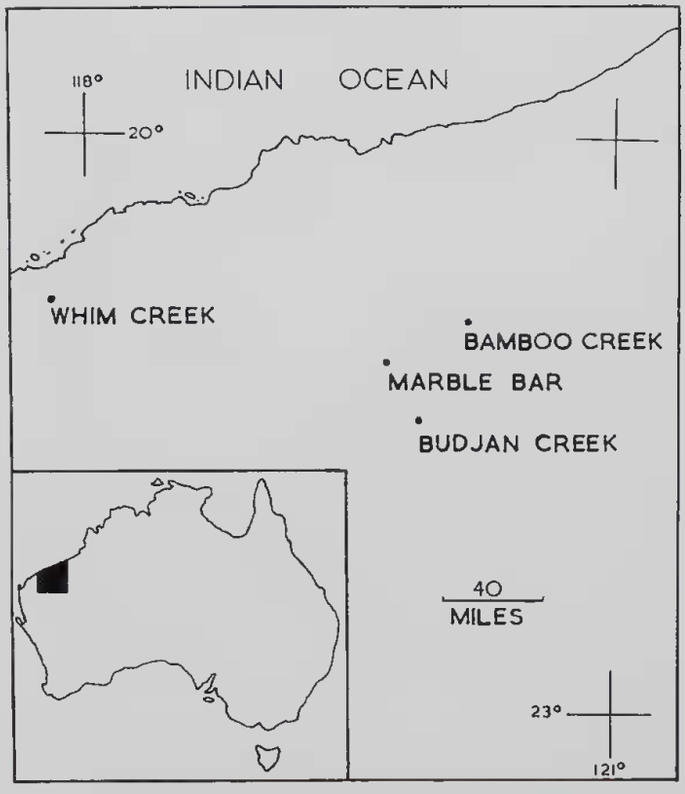

Fig. 1.—The distribution of *Heteronota spelea*.

Heteronota spelea, sp. nov.

Holotype; W.A.M. R12638: collected in "Prophecy West" mine at Bamboo Creek, Marble Bar District, Western Australia, by A. M. Douglas and W. D. L. Ride on October 12 or 13, 1957.

Paratypes: W.A.M. R12639-40; also collected in the "Prophecy West" mine and an unnamed adit at Bamboo Creek by A. M. Douglas and W. D. L. Ride on October 12 or 13, 1957.

Diagnosis: *Heteronota spelea* differs from *H. binoei* in possessing regular longitudinal rows of very small trihedral tubercles on the dorsum of the body (see Table 1) and four distinct brown bands on the body and nine to ten on the tail (Fig. 2). In *H. binoei* the tubercles are larger and more randomly scattered and the colour pattern is extremely variable.

Description of holotype: Head somewhat flattened; snout long; rostral rectangular, twice as broad as deep; dorsomedian rostral crease one-half height of rostral; nostril moderately large, directed posterolaterally, surrounded by rostral, first supralabial, one postnasal and two supranasals; anterior supranasal greatly enlarged, meeting counterpart on midline; scales posterior to supranasals greatly enlarged; loreal region strongly concave; 11/12 (right and left sides respectively) scales between postnasal and anterior margin of orbit; dorsal surface of snout slightly concave; supralabials 7/8 (from rostral to immediately below vertical pupil); fourteen scales between centrolateral margins of orbit (excluding supraciliaries and supraocular granules); external ear opening a small obscure slit at level of angle of jaw; mental triangular, much broader than long; primary postmentals meet on midline, greatly enlarged, almost twice as

TABLE I

The range of variation of certain meristic characters of *Heteronota spelea* and *H. binoei* from the zone of sympatry. (*) indicates the number of specimens examined.

	spelea	*binoei*	
	(8*)	Mt. Edgar (20*)	Marble Bar (10*)
Number of supralabials	6 to 9 (7·0)	5 to 6 (5·4)	5 to 6 (5·5)
Number of scales between postnasals and preocular granules	10 to 13 (11·2)	8 to 11 (9·6)	8 to 11 (9·3)
Number of keeled scales in primary paravertebral row between axilla and groin	24 to 29 (26·6)	17 to 21 (18·5)	16 to 19 (17·4)
Number of fourth finger subdigital lamellae	13 to 15 (13·6)	8 to 12 (10·7)	10 to 11 (10·6)
Number of fourth toe subdigital lamellae	14 to 18 (16·8)	12 to 14 (13·4)	12 to 14 (13·1)

long as broad, border rostral and first and second infralabials; secondary postmentals enlarged, separated on midline by three small scales; infralabials 8/9; throat region covered with small imbricating cycloid scales; supraocular, interorbital and occipital regions covered with keeled scales, temporal region with irregularly scattered trihedral tubercles and small keeled or smooth granules; dorsum of body covered with large trihedral tubercles in fourteen regular longitudinal rows, twenty-nine tubercles in primary paravertebral row between axilla and groin; longitudinal rows of trihedral tubercles continue on to neck and proximal part of tail; tubercles of longitudinal rows in contact or separated by a small keeled scale or conical granule; two or three conical granules separate primary paravertebral rows of tubercles, adjacent rows in contact or separated by a single conical granule; ventral surface of body covered with imbricating smooth cycloid scales equalling size of dorsal body tubercles; dorsal surface of limbs covered with keeled cycloid scales, those of proximal parts imbricate, distal parts juxtaposed; proximoventral surface of fore limb covered with large conical granules, distal sur-

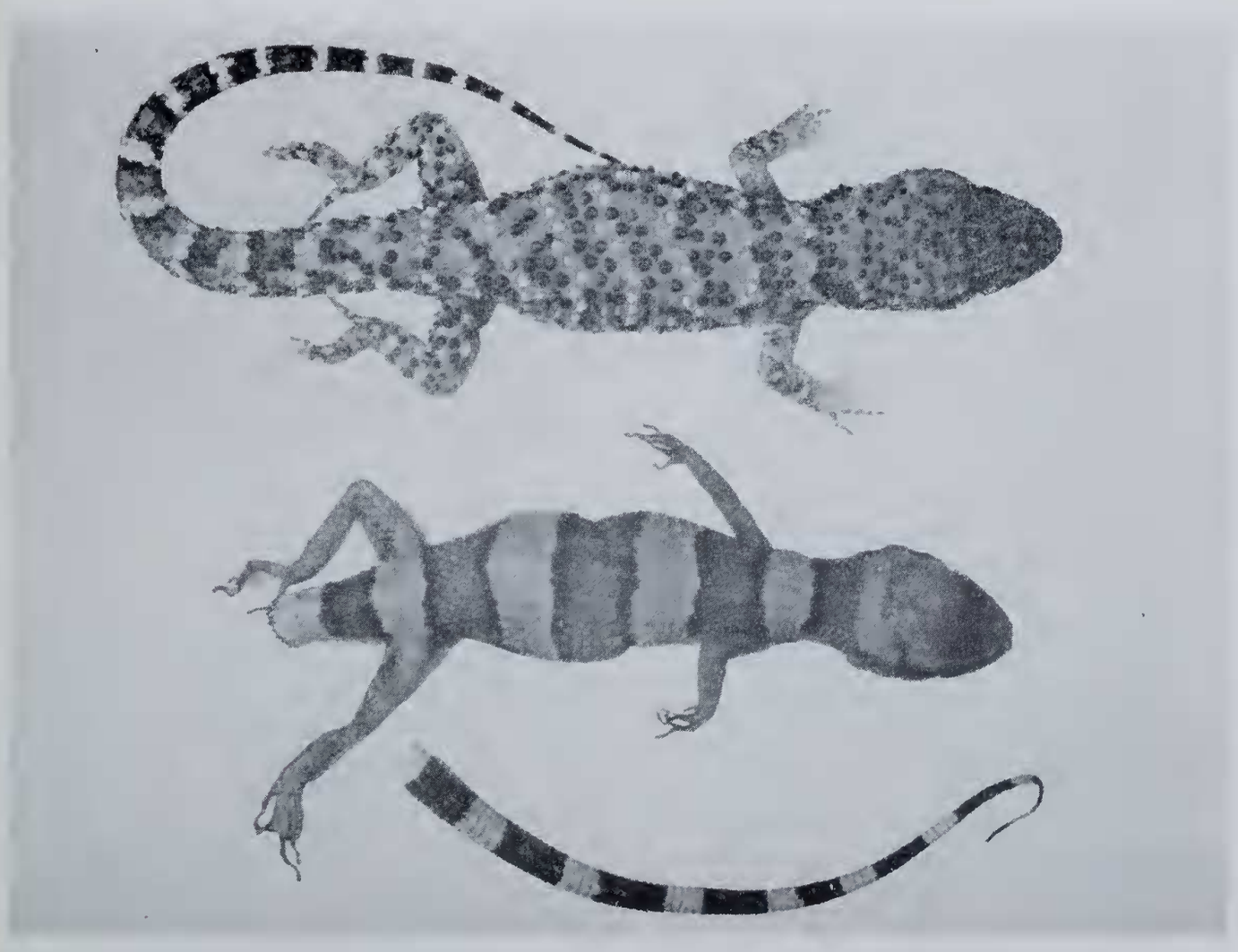

Fig. 2.—A dorsal view of *Heteronota binoei* (top) from Marble Bar and the holotype of *H. spelea* (bottom) from Bamboo Creek.

face with large imbricating cycloid scales; ventral surface of hind limb covered with large cycloid scales; posterior surface of thigh covered with small conical granules; dorsal, ventral and posterior regions of thigh sharply defined; digits long, slightly angulate, round in cross section proximally, laterally compressed distally; digits covered inferiorly with enlarged quadrangular subdigital lamellae, those of proximal regions somewhat swollen; claw short, strongly curved, surrounded by a single dorsal and two lateroinferior scales; palmar tubercle greatly enlarged and swollen; fourth finger with 13/14 sudigital lamellae; fourth toe with 17/17 subdigital lamellae; tail long and slender, covered dorsally with strongly keeled imbricating scales forming regular annuli; subcaudals greatly enlarged, bordered laterally by one large or two small scales; female; cloacal spurs indistinct.

Dorsal ground colour yellowish-white; snout covered with sparsely scattered brown chromatophores, heavily concentrated on rostral and labials; faint U-shaped brown mark on occiput; distinct brown postocular eye bar continuous with first brown dorsal band; four wide dark brown bands between nape and sacral region, yellowish-white interspaces equal width of bands (Fig. 2); ten ventrally incomplete dark brown bands on tail; interspaces narrower than bands; all ventral surfaces covered with scattered brown chromatophores, heaviest concentrations on throat region, hands and feet.

Snout-vent length 50.8 (all measurements in millimetres); tail length 75.5; head length 14.9; snout length 6.0; distance from eye to ear 4.8; head width 9.8; distance from axilla to groin 21 0; length of fore limb 17.0; length of fourth finger 3.8; length of hind limb 25.2; length of fourth toe 4.9.

Variation: The following data on external meristic variation are based on (a) paratypes R12639-40 from Bamboo Creek, (b) R12712 from Bamboo Creek, collected by W. D. L. Ride, 1958, (c) R13250 from a natural cave in a low level wash at Budjan Creek, Corunna Downs, collected by A. M. Douglas on May 26, 1959, (d) R14044 from the wall of an adit at approximately the 60 ft. level in the southwest corner of the copper mine at Whim Creek, collected by A. M. Douglas on December 6, 1961, (e) R540 from Marble Bar, collected by A. Brown, and (f) an unlabelled specimen without locality data. All of the above specimens are located in the Western Australian Museum.

Anterior supranasals separated by small granule in R12639; scales posterior to supranasals slightly to greatly enlarged; 10 to 13 (average 11.5) scales between postnasal and anterior margin of orbit; supralabials 6 to 9 (6.8); 15 to 17 (16.1) scales between centrolateral margins of orbit; external ear opening a small obscure slit or moderately large oval aperture; mental triangular to pentagonal; primary postmentals slightly to moderately enlarged, broader than long to almost twice as long as broad, border mental and first infralabial or first and second infralabials; secondary postmentals present or absent; infralabials 6 to 8 (6.7); supraocular, interorbital and occipital regions covered with flattened or elevated keeled scales; trihedral tubercles on body in 12 to 16 (13.6) longitudinal rows; 24 to 29 (26.3) tubercles in primary paravertebral row between axilla and groin; one to four conical granules separating primary paravertebral rows of tubercles, adjacent rows in contact or separated by one to two conical granules; fourth finger with 13 to 15 (13.6) subdigital lamellae; fourth toe with 14 to 18 (16.8) subdigital lamellae; cloacal spurs consist of two to three enlarged fleshy scales in a diagonal row at base of hind limb insertion (apparently no sexual difference in size or number); males, R13250 and unlabelled specimen, with six preanal pores in relatively continuous straight row; U-shaped occipital mark very distinct; nine to ten ventrally incomplete dark brown tail bands.

Discussion: The known geographic range of *Heteronota spelea* is less than 160 miles wide at its extremes (Fig. 1) and is very small when compared to that of the extremely common *H. binoei* which has been recorded from the Shark Bay region of Western Australia to the Cape York Peninsula of Queensland (absent only from the south-western and south-eastern corners of the continent). Apparently *H. binoei* is sympatric over the entire, although limited, range of *H. spelea*. Both species have been collected at Marble Bar and *H. binoei* is very common at Mt. Edgar which is almost equidistant between the Budjan Creek and Bamboo Creek localities of *H. spelea*. Table I shows some of the more obvious morphological differences between the two species in the zone of sympatry.

A large part of the North-West Natural Region is dominated by breakaways which are characterized in part by natural quarries. The region is provided with a still greater number of subterranean cavities as a result of extensive mining in the last 75 years. It is possible that the major reason for the survival of *Heteronota spelea*, in spite of its close association with the apparently highly successful *H. binoei* is that it is restricted to these cavities. *Heteronota binoei* is normally found in open country under natural debris and articles of human habitation. The limited range and peculiar habitat of *H. spelea* suggest that it is a geographical relict. The method and time of speciation will be discussed in a later paper dealing with patterns of speciation in Australian gekkonid lizards.

Although the genus *Heteronota* is endemic to Australia it does not appear to belong to the peculiar diplodactyline group which forms the major portion of the Australian gecko fauna. Based on the general similarity of external meristic and measureable characters *Heteronota* appears to be most closely related to the genus *Cyrtodactylus* which ranges from northeast Africa through southern Asia and Australasia to the Pacific Islands. The only external morphological features that can be used to differentiate between the two genera are associated with the digits. In *Heteronota* the digits are relatively straight, with two rows of lateral scales and with the claw situated between a single dorsal and two lateroinferior plates. In *Cyrtodactylus* the digits are angular, with three or more rows of lateral scales and the claw is

surrounded by single dorsal and ventral plates. In addition to the diagnostic characters listed above, Underwood (1954) stated that the subcaudals in *Cyrtodactylus* are commonly not or but slightly enlarged transversely (in *Heteronota* the subcaudals are greatly enlarged transversely). Underwood's generalization requires qualification as Boulenger (1885) and de Rooij (1915) noted that the subcaudals are greatly enlarged in many species now referred to *Cyrtodactylus*.

Underwood (1957) postulated four gekkotan invasions of Australia. He suggested that *Heteronota* belonged to the third migration which followed the diplodactyline movement, however, distinct from that of the recent expanding modern dominants, i.e. *Gekko* and *Hemidactylus*. The probable time and route of entry into Australia must await a much more complete systematic and zoogeographic study of Australasian geckos.

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